RECORD OF DECISION
DECLARATION STATEMENT

SITE NAME AND LOCATION

48th and Holly Landfill (Operable Units 3 and 6), Sand Creek Industrial Superfund Site, Commerce City, Colorado

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Operable Units 3 and 6 (OU3/OU6), the 48th and Holly Landfill (the "Landfill"), at the Sand Creek Industrial Superfund Site in Commerce City, Colorado. This remedial action has been developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), applicable state laws, and the National Oil and Hazardous Substances Pollution Contingency Plan (the National Contingency Plan (NCP), Title 40 Code of Federal Regulations Part 300). This decision is based on the administrative record for OU3/OU6.

The State of Colorado concurs with the selected remedy.

ASSESSMENT OF THE OU3/OU6

Actual or threatened releases of hazardous substances from the Landfill, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

The remedial action selected for OU3/OU6 will address the principal threats existing at the Landfill and will ensure that: (1) emissions of landfill gas are controlled to prevent inhalation at levels that pose an endangerment to human health or the environment, (2) accumulation of landfill gas is minimized in order to prevent explosion hazards, (3) dermal contact with the landfill contents is prevented, and (4) the use of ground water underlying the Landfill as a drinking water source is prevented.

The major components of the selected remedy include:

- Continued operation and maintenance of the OU6 landfill gas-extraction system (LFGES) with improvements as required during the normal course of operation and maintenance activities;

- Continued maintenance of the soil cover system with improvements as required during the normal course of operation and maintenance activities;

- Continued maintenance of the perimeter fence and warning signs;

- Continuation of existing institutional controls, and implementation of additional institutional controls, as necessary;

- Implementation of the OU3 monitoring program and periodic site reviews.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for OU3/OU6. Operation of the LFGES to extract and treat landfill gas addresses the principal threat at the Landfill and satisfies the statutory preference for treatment as a principal element. Condensate generated during operation of the LFGES will be treated by a POTW.

The size of the Landfill and the fact that there are no on-site hot spots that represent the major sources of contamination preclude a remedy in which contaminants could be excavated and treated effectively. However, hazards associated with exposure to landfill contents will be minimized through containment, by maintaining the soil cover system. Groundwater contamination attributable to OU3 is not considered to be a principal threat, and potential exposure pathways for ground water have been addressed to the extent practicable.

Because this remedy will result in hazardous substances remaining on-site, a review will be conducted every five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Jack W. McGraw — 6/30/93

Jack W. McGraw, Acting Regional Administrator
U.S. Environmental Protection Agency, Region VIII

Date

Thomas P. Looby, Director
Colorado Department of Health

Date

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48th AND HOLLY LANDFILL (OPERABLE UNITS 3 AND 6)
SAND CREEK INDUSTRIAL SUPERFUND SITE, COMMERCE CITY, COLORADO
RECORD OF DECISION

I. SITE NAME, LOCATION, AND DESCRIPTION

The Sand Creek Industrial Superfund Site (Figure 1) occupies about 300 acres within portions of both Commerce City in Adams County, Colorado and the City and County of Denver, Colorado. The site is centered near the intersection of 52nd Avenue and Dahlia Street. U.S. Interstate 270 is directly north of the site. Four known sources of contamination are present at the Sand Creek Industrial Superfund Site, and all are currently inactive: the Colorado Organic Chemical property, the 48th and Holly Landfill, the L.C. Corporation (LCC) property, and the Oriental Refinery property (a source of petroleum contamination). The 48th and Holly Landfill (Operable Units 3 and 6; OU3/OU6), hereafter referred to as "the Landfill," is the focus of this Record of Decision (ROD) and is located in the southern portion of the Sand Creek Industrial Superfund Site. The Landfill encompasses an area of approximately 150 acres and is bordered on the north by East 52nd Avenue, on the south by East 48th Avenue, on the west by Dahlia Street, and on the east by the intersection of the railroad right-of-way and East 48th Avenue, approximately one-quarter mile east of Ivy Street.

Land use near the Sand Creek Industrial Superfund Site is primarily industrial and includes trucking firms, petroleum refining operations, chemical production and supply companies, warehouses, and small businesses. Several other Superfund sites are also located in the area, including the Rocky Mountain Arsenal, Chemical Sales Company, and Woodbury. Properties adjacent to the site are zoned for light and heavy industrial, industrial park, industrial park storage and agricultural uses. Fifteen residences with approximately 25 people are located within a mile radius of the site. The daytime population reaches several hundred due to the local businesses and industrial nature of the area. The entire Denver parcel is zoned for heavy industrial use. No changes in zoning are anticipated by the City and County of Denver Planning Administration (CCDPA) in the near future. CCDPA indicates that long-range land-use plans will depend on the fate of Stapleton International Airport following completion of the new Denver International Airport.

The Commerce City parcel is zoned for agricultural and heavy industrial use. Commerce City's Comprehensive Plan for 1985 to 2010 indicates that future land use of this area will be primarily industrial with a recreation/open space designation for the Sand Creek floodplain.

Municipal water for the metropolitan area surrounding OU3/OU6 is supplied by the South Adams County Water and Sanitation District (SACWSD) and the Denver Water Department (DWD). Ground water produced from alluvial and bedrock wells

Figure 1. **Location of the 48th and Holly Landfill (OU3/OU6) at the Sand Creek Industrial Superfund Site, Commerce City, Colorado.**

located north of I-270 is a major source of water supplied by SACWSD. Water supplied by the DWD is obtained primarily from surface-water sources located outside of the Sand Creek Industrial Superfund Site area.

In 1990, the Tri-County Health Department (TCHD) prepared an inventory of private wells within the areas bounded on the north by Sand Creek, on the south by Interstate 70 (I-70), on the west by Colorado Boulevard, and on the east by Quebec Street. The Landfill is located within these boundaries and covers most of the western two-thirds of .he survey area. The purpose of the inventory was to identify the locations and uses of all wells within the study area. Results indicated only two properties where private wells are used for drinking water and both wells were completed in the Arapahoe Formation (a bedrock aquifer).

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Before filling operations began at the Landfill, the land was used primarily for agricultural purposes. A review of aerial photographs taken in 1956 and 1964 shows that sand and gravel mining operations occurred along the southern boundary of the Landfill. Aerial photographs also show that in 1967, a finger drain system, consisting of a series of clay tile lateral collector drains, was reportedly installed along the base of an erosional escarpment located along the south side of the Landfill near 48th Avenue. The reported purpose of the drain system was to intercept groundwater seepage from the terrace deposits forming the escarpment. The drain system routes water beneath the Landfill through a concrete drainpipe which empties via a corrugated metal drainpipe into a 1-acre wetland area adjacent to the Landfill.

Aerial photographs indicate that municipal landfilling operations began at the portion of the Landfill east of Ivy Street in 1967. In 1968, landfilling operations were initiated west of Ivy Street. According to the former Landfill operator, fill activities began at the south end of the Landfill and proceeded to the north in one layer or "lift." Daily cover material was graded from on-site areas, and the waste was watered to aid compaction.

The Landfill accepted both demolition and domestic refuse, and the trash was sorted before dumping. Metal refuse, such as stoves and refrigerators, was placed under the Colorado and Eastern Railroad Company right-of-way. Known hazardous and pathological wastes were reportedly excluded from disposal at the Landfill; however, the method used to exclude these wastes is not known. In addition, it is not known whether this reported operating practice was consistently employed. The Landfill was closed in 1975, and the area was revegetated.

In June 1977, two men were killed and five injured in two explosions of combustible gases that occurred in a water conduit under construction by the DWD northwest of the intersection of 52nd Avenue and Dahlia Street. A subsequent investigation by the Colorado Department of Health (CDH), TCHD, and the South Adams County Fire Prevention Bureau (SACFPB) concluded that the explosions were caused by methane gas migrating from the Landfill. In response to the explosions and the detection of combustible gases migrating offsite, two methane gas venting systems were installed at the Landfill. Burlington Northern Railroad (BNR), in cooperation with TCHD and CDH, installed an experimental passive venting system utilizing wind turbines along the perimeter of the western 25-acre portion of the Landfill in 1978. In early 1980, an additional passive methane-gas venting system was installed in the eastern portion (east of Ivy Street) of the Landfill. Following the explosion, TCHD and SACFPB also periodically monitored for methane gas in businesses surrounding the Landfill. The detection of methane gas in nearby buildings, especially around cracks in foundations and basement walls, supported the conclusion that methane gas was migrating offsite of the Landfill. In 1981, TCHD determined that the passive venting system was ineffective, and as a result, BNR installed an active venting system along the southwest and northwest edge of the Landfill. Gases collected in this system were vented to the surface through three stacks.

In 1982, the U.S. EPA Field Investigation Team (FIT) performed an evaluation of the Sand Creek Industrial Site to see if it should be placed on the National Priorities List (NPL). A composite migration score (SM) of 59.65 was calculated for the site, and in December 1982 the Sand Creek Industrial site was added to the NPL. In its investigation, FIT conducted groundwater sampling downgradient of the Landfill as well as soil and surface water sampling in order to assess the degree of contamination in the area. Analytical results indicated the presence of several volatile organic compounds (VOCs) in ground water, including 1,1-dichloroethane (1,1-DCA); 1,2 trans-dichloroethene (1,2 trans-DCE); 1,1,1-trichloroethane (1,1,1-TCA); and 1,1-dichloroethene (1,1-DCE). Inorganic compounds that were detected at concentrations elevated above background levels included arsenic, cadmium, nickel, and zinc.

In late 1983, BNR installed 12 monitoring wells within and around the Landfill and collected groundwater and surface-water samples for analysis. Concentrations of arsenic, selenium, lead, antimony, and phenols exceeded EPA drinking water standards or clean water standards in the area. In January 1984, EPA resampled these locations in the northern portion of the Landfill. Elevated levels of volatile organics (benzene; chloroform; 1,2-DCA; 1,1-DCE; 1,2 trans-DCE; tetrachloroethene (PCE); and 1,1,1-TCA), heavy metals (cadmium, iron, and manganese), and one phthalate ester were noted in ground water.

In April 1985, Camp Dresser & McKee, Inc. (CDM) began preparation of a Remedial Investigation/Feasibility Study (RI/FS) for the Sand Creek Industrial Superfund Site. The site characterization report was completed in 1988. During that time, BNR continued to investigate possible groundwater contamination in the vicinity of the Landfill. Four newly installed wells and three existing wells were sampled and indicated the presence of slightly elevated concentrations of total dissolved solids (TDS) and iron, and low concentrations of 1,1-DCE and 1,1-DCA downgradient of the Landfill.

In August 1987, Engineering-Science, Inc. (ES) collected and analyzed one air sample from each of the three active methane gas venting stacks to determine whether emissions could cause adverse health effects. In addition, ES collected four surficial soil samples to assess emissions resulting from the upward diffusion of gas through the Landfill cover. Collectively, sixteen VOCs were detected in the stack vent gas samples. No indication of contamination was observed in the soil samples from the landfill cover.

On February 8, 1990 EPA issued an Administrative Order on Consent (AOC; Docket No. CERCLA-VIII-90-08) to Landfill, Inc. (LI) and BNR to perform an RI/FS for the 48th and Holly Landfill (OU3). EPA's Statement of Work (SOW) in the OU3 AOC included the existing Landfill, the spring emerging from the toe of the Landfill, and the associated surface-water drainage to the point where the drainage enters a concrete-lined ditch. Harding Lawson Associates, Inc. (HLA) on behalf of LI and BNR, completed the draft revised Risk Assessment (RA) in April 1992 and the final OU3 RI in June 1992. In response to EPA comments and current Superfund guidance, the OU3 RA was revised and finalized in early 1993. The Focused Feasibility Study (FFS) for OU3 was completed and submitted to EPA in March 1993.

On August 15, 1990 EPA issued a Unilateral Order (Docket No. CERCLA-VIII-90-20) to LI and BNR which delineated the PRPs' role in the OU6 Removal Action. The OU6 Order addressed explosive and health risks associated with gaseous emissions released from the Landfill and became effective on August 25, 1990. An amendment issued in September 1990 to the OU3 AOC provided for the inclusion of gaseous emissions from the Landfill (i.e., OU6) under OU3 following the full implementation of the OU6 Removal Action.

In November 1990, an Engineering Evaluation/Cost Analysis (EE/CA) was prepared for OU6 at the Landfill. The report described the site conditions which justified a Removal Action, identified Removal Action objectives, discussed remedial alternatives, and presented the chosen remedy. EPA prepared an Action Memorandum to request and document approval of the PRP-financed Removal Action for OU6 in December 1990. An active landfill gas-extraction system (LFGES) was installed by LI and BNR, which began operation in June 1991 as part of the OU6 Removal Action. The LFGES replaced the previously installed systems and consists of a series of gas extraction wells interconnected by gas collection piping. Two centrifugal blowers connected to a single point in the gas collection system are operated alternately to induce the flow of gases from the gas extraction wells. The gas is diverted to an enclosed flare system for treatment. The enclosed flare system is designed to destroy odors and toxic components of the landfill gas. Gas monitoring probes are also installed around the perimeter of the Landfill to monitor the LFGES performance. The probes are monitored at least monthly for methane concentrations and gas pressure.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

The community has expressed limited interest in OU3 and OU6, specifically, and the Sand Creek Industrial Superfund Site, in general. EPA has undertaken several community relations activities to keep the public informed of issues related to the Landfill.

Community involvement activities for the Sand Creek Industrial Superfund Site began in April 1985. EPA distributed an introductory fact sheet to area residents, businesses, and agencies. The fact sheet provided background information about the site and an explanation of the Superfund process. EPA also attended a public meeting organized by the Citizens Against Contamination, a local group from the area, and compiled a list of property owners for the entire site.

EPA mailed a second fact sheet for the Sand Creek Industrial Superfund Site in November 1985. This fact sheet provided additional information on investigation and clean-up activities associated with hazardous waste sites. During the same month, EPA provided a groundwater contamination briefing at a second public meeting held by the Citizens Against Contamination.

In January 1986, EPA contacted property owners and Commerce City officials to inform them of activities at the Sand Creek Industrial Superfund Site. In April 1987, EPA surveyed area residents about their water-use habits to determine future outreach efforts.

An RI report describing the nature and extent of contamination at the Sand Creek Industrial Superfund Site was released for public review in March 1988. In May 1988, EPA contacted owners for permission to sample soils on their property. In October 1988, EPA met with Commerce City officials to brief them and solicit their reaction to clean-up plans for the site.

On three occasions in 1990, EPA held public meetings addressing all of the Superfund sites in South Adams County, excluding the Rocky Mountain Arsenal. At each meeting, EPA presented its intentions for the Removal Action at OU6 and encouraged public participation. A public comment period was held from October 9, 1990 to November 9, 1990 for the OU6 EE/CA, and no comments were received by EPA.

In the fall of 1991, community interviews were conducted to update the site Community Relations Plan (CRP) originally issued in December 1984. The CRP outlines community concerns, EPA's strategy for implementing the plan, and establishes information repositories. A list of contacts and interested parties throughout government and the local community are also provided. The CRP was released in December of 1991. In addition to meeting directly with the public, EPA and the CDH have met with the Tri-County Health Department staff, South Adams County Water and Sanitation District, Rocky Mountain Arsenal personnel, Commerce City/Adams County officials, Metro Waste Water officials, and Representative Patricia Schroeder's staff to update them on OU3/OU6 activities.

On June 3, 1992 a public meeting was held to discuss the Risk Assessment prepared for OU3. EPA issued the Proposed Plan for OU3/OU6 to the public on March 19, 1993. The Proposed Plan as well as the RI, RA, and FFS reports were made available to the public through the Administrative Record maintained at the EPA Region VIII Superfund Records Center in Denver and at the information repository at the Adams County Library. A notice of availability of these documents and notification of the public meeting were published in *The Rocky Mountain News* on March 28, 1993 and in the *Commerce City Express* on March 30, 1993.

The public comment period for the OU3/OU6 Proposed Plan was open from March 22, 1993 to April 21, 1993. The public meeting was held at 5:30 p.m. on March 30, 1993 at the Commerce City Recreation Center. EPA explained the alternatives and responded to questions. A transcript of the public meeting has been entered into the Administrative Record. No written or oral comments were received.

IV. SCOPE AND ROLE OF RESPONSE ACTION

Due to the complex nature of the Sand Creek Industrial Superfund Site, EPA has divided it into six OUs, or study areas, in order to more effectively address specific contamination problems. The OUs were established based on the types of contaminants present, the type of media affected, and physical characteristics. As discussed above, two OUs (3 and 6) pertain specifically to the 48th and Holly Landfill. The six operable units at the Sand Creek Industrial Superfund Site are as follows:

- Operable Unit 1: OU1 addresses contaminated buildings, soil contamination greater than 1000 parts per million (ppm), and VOCs in the soils. The OU1 area includes approximately 15 acres of the site, including the Colorado Organic Chemical plant property, the land between Colorado Organic Chemical and the L.C. Corporation, and the northern portion of the Oriental Refinery site.

- Operable Unit 2: This OU addresses the acid waste disposal pits, just north of the Colorado Organic Chemical property, commonly referred to as the L.C. Corporation. It is reported that pits located there were used for disposal of acid waste from various chemical manufacturing activities occurring both off and on site.

- Operable Unit 3: This study area comprises the 48th and Holly Landfill and specifically includes contaminated surface water, ground water, sediment, soil, and air in its vicinity.

- Operable Unit 4: This study area comprises the entire site-wide contaminated ground water.

- Operable Unit 5: OU5 includes the same area as OU1, but addresses pesticides and heavy metals in soils to a depth of 5 feet with contamination greater than action levels and less than or equal to 1000 ppm. There are up to approximately 14,000 cubic yards of contaminated soil in OU5.

- Operable Unit 6: This OU addresses the gaseous emissions at the 48th and Holly Landfill.

At the present time, RODs have been prepared to address remediation action for OU1, OU2, and OU5 at the Sand Creek Industrial Superfund Site. A ROD amendment is currently being developed to address fundamental changes made to the selected remedy for OU5, and the RI/FS for OU4 will be completed in the summer of 1993.

This ROD addresses the principal potential threats to humans and the environment resulting from exposure to the 48th and Holly Landfill (OU3/OU6). As noted above, an amendment (September 1990) to the OU3 Administrative Order for the RI/FS allowed for the inclusion of gaseous emissions from the Landfill in OU3 after the OU6 Removal Action had been fully implemented. The OU3 FFS evaluated three alternatives for reducing exposure to contaminated surface water and landfill gas. Ground water, sediment, and soil were assessed, but remedial alternatives were not considered as a result of evaluation of media of concern and potential exposure pathways addressed under OU3. Specific objectives of the remedial action selected for OU3/OU6 are as follows. Landfill and off-site workers as well as off-site residents will be protected from the landfill contents and gas by ensuring that: (1) emissions of landfill gas are controlled to prevent inhalation at levels that pose an endangerment to human health or the environment, (2) accumulation of landfill gas is minimized in order to prevent explosion hazards, (3) dermal contact with the landfill contents is prevented, and (4) the use of ground water underlying the Landfill as a drinking water source is prevented.

A groundwater monitoring program will be implemented at the site to assess changing aquifer conditions and to continue evaluating the Landfill's impact on groundwater quality. The groundwater monitoring data will provide information for conducting periodic site reviews. In the future, such as when the remedial action for the Chemical Sales site is complete, if it is determined from subsequent evaluations that the Landfill is responsible for unacceptable groundwater contamination, remediation of the ground water at the Landfill will be addressed under OU3.

V. SUMMARY OF SITE CHARACTERISTICS

The Sand Creek Industrial Superfund Site, including the 48th and Holly Landfill, is located in an urban environment that has been extensively modified by industrial development over the past 50 years. The site lies in an area of low relief within the Sand Creek flood plain, which is part of the South Platte River system. The on-site drainage represents less than one-half of one percent of the total drainage to Sand Creek. The only surface-water feature within the Landfill study area is a 1-acre wetland located immediately north of the Landfill. The wetland receives water from a "spring" that discharges from a corrugated metal pipe. This pipe is connected to finger drains that were installed before landfilling operations began to divert seeps originating along the escarpment to the south.

The Landfill is in an area classified as mid-latitude semiarid, indicating an area of high summer temperatures, cold winters, and sparse rainfall. The average annual precipitation is approximately 15 inches.

A. Surface Geology

Topography in the area rises gently to the south, with elevations ranging from approximately 5,180 feet above mean sea level (MSL) in the northwestern corner of the site to approximately 5,250 feet MSL in the southeastern corner. Interpretation of natural features is complicated by the extensive amount of fill that has been brought into the area. Between 2 and 10 feet of soil capping material currently covers the refuse at the Landfill. Natural drainage paths also have been altered by development in much of the area. Natural surficial deposits consist of Pleistocene and Holocene alluvium, eolian sediments, and loess. Alluvial deposits in the vicinity of OU3/OU6 range in thickness from less than 20 feet to more than 100 feet. The deposits generally consist of interbedded gravel, sand, silt, clay, and minor amounts of cobbles and pebbles. In addition, paleochannels eroded in the bedrock may influence the occurrence and movement of ground water in the area.

B. Subsurface Geology

The subsurface geology in the vicinity of the Landfill consists of Quaternary alluvial deposits and Tertiary bedrock. Alluvial deposits consist of sand, silt, and clay of the Piney Creek alluvium, eolian deposits of silt and clay, and sand and gravel of the Broadway alluvium. Clay and gravel sediments of the Slocum alluvium are also locally present. Bedrock in the area is made up of claystone, shale, siltstone, and sandstone of the Denver formation. The Denver formation is underlain by the Arapahoe formation, Laramie formation, and Fox Hills sandstone. Outcrops of bedrock are not visible at the Landfill.

C. Hydrogeology

Three discrete aquifers (Aquifers 0, 1, and 2) have been identified within the unconsolidated sediment overlying bedrock in the vicinity of the Landfill. Bore hole logs taken from investigations in the vicinity of the Landfill show that alluvial deposits are composed of relatively high permeability sands and gravels interbedded with low permeability clayey and silty material.

In the southeastern portion of the Landfill, Aquifer 0 is the only alluvial aquifer present, and it directly overlies bedrock or fine-grained alluvial sediments overlying bedrock. In the central part of the Landfill, Aquifer 0 exists under perched conditions above Aquifer 2. Aquifer 0 is unconfined throughout the Landfill and is underlain by a low permeability clayey layer (Aquitard A), which inhibits downward movement of ground water. Within Aquifer 0, groundwater flow is generally toward the north to northwest.

Aquifer 0 receives recharge from upgradient of the Landfill and discharges to Aquifer 2 where the confining unit separating these aquifers pinches out in the northwest portion of the Landfill. Aquifer 0 also discharges to the spring located north of the Landfill via the finger drain system. The direction of groundwater flow in Aquifers 0 and 2 is generally consistent with the regional flow direction of the alluvial system.

Aquifer 1 is present northwest of the Landfill, including the extreme northwestern portion of the Landfill. Aquifer 1 exists under unconfined conditions and is separated from Aquifer 2 by a clayey impermeable unit (Aquitard B). Groundwater flow within Aquifer 1 is generally toward the east. Ground water may discharge from Aquifer 1 to Aquifer 2 in the area where the confining unit separating these aquifers pinches out, in the vicinity of the northern boundary of the Landfill.

The third alluvial aquifer (Aquifer 2) is present over the western two-thirds of the Landfill. Aquifer 2 underlies Aquifer 0 and Aquifer 1 in areas where present and overlies fine-grained alluvial sediments overlying bedrock. Aquifer 2 exists under confined conditions to the west and northwest of the Landfill but is unconfined beneath the Landfill and south of the site. Groundwater flow within Aquifer 2 is generally toward the north.

D. Nature and Extent of Contamination

A site-wide RI completed in 1988 identified several contaminants in various operable units. The sources and extent of contamination were not well established because of the limited number of samples taken. Therefore, additional samples were collected during the OU3 RI to verify or better define contamination associated with the

Landfill. The following media were assessed for the presence of contamination in the vicinity of the Landfill:

- Surficial soil
- Ground water
- Surface water and sediment
- Air/landfill gas

Surficial soil samples collected during previous investigations within OU3 and during the OU3 investigation of sediment within the spring discharge area indicated that contaminants are not present in these two media. Therefore, the Landfill is not considered a contributor of contaminants to surficial soil and sediment.

Several VOCs, including 1,1,1-TCA; 1,1-DCA; 1,1-DCE; 1,2-DCE (total); chloroform; PCE; and TCE were detected in surface-water samples collected from the spring discharge area. The VOCs detected in surface water are essentially the same as those detected upgradient of the Landfill in the Chemical Sales site contaminant plumes in Aquifer 0. Due to the similarity of compounds detected upgradient and downgradient of the Landfill, and the origin of the water discharged to the spring, the OU3 RI concluded that the most likely source of surface-water contamination is the contaminated groundwater plumes in Aquifer 0 that resulted from past releases from the Chemical Sales site.

Groundwater samples collected from Aquifers 0, 1, and 2 and water samples collected from the landfill gas-extraction wells had detectable levels of a number organic and inorganic constituents. VOCs were the most widespread of the organic constituents detected in groundwater samples and were detected at the highest concentrations. Semi-volatile organic compounds (SVOCs) were also detected in these samples. The distribution and range of concentrations for the SVOCs were significantly lower than those observed for the VOCs.

Major sources of groundwater contamination exist in the vicinity of OU3. These sources include the Chemical Sales site, located southeast of the Landfill, and the Colorado Organic Chemical Company and Oriental Refinery sites, located west of the Landfill. Substantial plumes of VOCs within Aquifer 0, including PCE; TCE; 1,1-DCE; 1,1-DCA; cis-1,2-dichloroethene (cis-1,2-DCE); 1,1,1-TCA; vinyl chloride; methylene chloride; and carbon tetrachloride emanate from the Chemical Sales site and extend to the north at least as far as Sand Creek. Concentrations of several VOCs within these plumes exceed 10,000 micrograms per liter ($\mu g/l$) near the source area. These contaminated groundwater plumes from the Chemical Sales site pass beneath the eastern portion of the Landfill and may affect groundwater quality downgradient of OU3/OU6.

Major plumes of hydrocarbon compounds, including benzene, toluene, ethylbenzene, xylenes, chlorinated VOCs, and SVOCs are present within Aquifer 1.

These plumes emanate from the Colorado Organic Chemical Company and/or Oriental Refinery sites (OU1 and OU5) and extend northeast to Sand Creek. The contaminant plumes may pass beneath the extreme northwestern portion of the Landfill and affect groundwater quality downgradient of OU3/OU6.

Pesticides and herbicides were generally not detected in ground water in the vicinity of the Landfill. The inorganic constituents detected in groundwater samples were generally consistent upgradient and downgradient of the Landfill. However, a limited number of inorganic constituents appeared to be slightly elevated in downgradient monitoring wells relative to the range of concentrations observed in upgradient wells. The inorganic constituents detected most frequently at significantly elevated concentrations include iron and manganese. A few additional inorganics including antimony, barium, cadmium, calcium, cobalt, magnesium, nickel, potassium, sodium, and chloride, were detected downgradient of the Landfill at slightly elevated levels.

Water samples were collected from selected landfill gas-extraction wells during construction of the LFGES to assess the presence of contaminants within the Landfill. The most frequently detected organic constituents include ketones, benzene, ethylbenzene, toluene, total xylenes, and several chlorinated VOCs. The ketones were detected in the highest concentrations, ranging as high as 5600 $\mu g/l$ for 2-butanone. Chlorinated VOCs were detected less frequently and at generally lower concentrations. The compounds detected most frequently in samples from landfill gas-extraction wells were generally not detected in monitoring wells located downgradient of the Landfill. Inorganic constituents were detected in samples from landfill gas-extraction wells at concentrations significantly exceeding background concentrations in Aquifer 0.

As discussed in the OU3 RI, the chemical data for the various media indicate that the Landfill is not contributing significantly to organic and inorganic contamination downgradient of the Landfill. Other source areas in the vicinity of the Landfill are clearly contributing substantial levels of organic constituents to ground water, both upgradient and downgradient of the Landfill. The Chemical Sales site appears to be the source for most of the chlorinated VOCs that are detected in the ground water.

The inorganic analytical data indicate that iron and manganese may originate in the Landfill. These constituents are elevated in the landfill gas-extraction well water samples and are also observed at elevated levels downgradient of the Landfill.

Air samples were collected from stack vents associated with landfill gas-collection systems formerly operating at the Landfill. Analytical results for these samples showed the presence of several VOCs, including benzene; chloroform; 1,1-DCE; PCE; and vinyl chloride. Most concentrations were less than 10 mg/m^3. In addition, the methane gas explosions that occurred near the Landfill in 1977 indicated that landfill gas is capable of migrating from the Landfill. The LFGES installed at the Landfill in 1991 as part of the

OU6 Removal Action is designed to prevent the migration of landfill gas from the Landfill.

E. Water Diversions

The rights for surface-water diversion from Sand Creek exist at two separate locations downstream of the Landfill. The first diversion point is the proposed Henrylyn Sand Creek Diversion, which is approximately 1.5 miles downstream of the Sand Creek Industrial Superfund Site on the northeast quarter of Section 12, Township 3 South, Range 68 West (T3S, R68W). Diversions from this location could reach 250 cubic feet per second of water for direct irrigation and storage in existing and planned reservoirs. The second diversion point is approximately 2 miles downstream of the Sand Creek Industrial Superfund Site where the Burlington Ditch intersects Sand Creek. A maximum of 250 cubic feet per second of water is appropriated for irrigation and domestic use at this location. According to a representative of the Burlington Ditch Company, water rights along the proposed Henrylyn Sand Creek Diversion or the existing Burlington Ditch have not been exercised to date.

VI. SUMMARY OF OU3/OU6 SITE RISKS

CERCLA mandates that EPA protect human health and the environment from current and potential exposures to hazardous substances at the 48th and Holly Landfill. Therefore, a Risk Assessment (RA) was prepared for OU3 to evaluate potential human health and environmental baseline risks associated with contamination at the site in the absence of any remedial action. The OU3 RA supplements and updates a previous RA prepared in 1987 for the Landfill by incorporating data collected during the OU3 RI. The OU3 RA also addresses risks posed by baseline conditions present at OU6 prior to implementation of the Removal Action. Two primary types of hazards are associated with the Landfill: the potential health hazard posed by contamination related to the Landfill, and the potential explosive hazard associated with methane gas generated within the Landfill.

A. Contaminants of Concern

Ground water in Aquifers 0, 1, and 2, surface water, and air were identified as media of concern in the OU3 RI. Soil and sediment were eliminated since investigations indicated that they were not significantly contaminated. Analytical data collected from 1986 through 1991 for the media of concern were evaluated according to EPA data validation criteria, a concentration toxicity screen was performed, and the fate and transport properties of individual chemicals were examined in developing a list of chemicals of concern (COC) for the Landfill. The 23 COCs selected include VOCs, SVOCs, and metals. These contaminants represent all the carcinogenic chemicals detected in media of concern and the non-carcinogenic chemicals present that are the most likely to pose the greatest relative risk to humans and the environment. Chemicals detected in stack vent air samples and used as indicator chemicals in the previous RA are also considered as COCs for the air medium. A list of COCs for specific media of concern is presented in Table 1.

B. Exposure Assessment

Exposure pathways and receptors were identified based on the OU3 site conceptual model. Potential release mechanisms associated with the Landfill include leaching of chemicals in refuse and their subsequent movement into ground water, and volatilization of landfill gas. Although an active LFGES is currently operating at the Landfill, baseline conditions that were present before remedial measures were implemented were considered in assessing risk associated with the Landfill. Transport processes at the Landfill include groundwater flow and withdrawal, groundwater discharge to surface water, and dispersion of VOCs from the Landfill.

Exposure pathways that were quantitatively evaluated for the current land-use scenario in the OU3 RA are: inhalation of ambient air for local residents, nearby workers, nearby neighborhoods, and the nearest school; and dermal exposure to surface water for children potentially wading in the spring discharge area. Environmental receptors (i.e., plants and wildlife) potentially exposed to COCs in surface water were also qualitatively assessed. Under the current land-use scenario, no human receptors are known to be exposed to chemicals at the Landfill via the domestic use of ground water. The ground water beneath the Landfill is classified by the State of Colorado as a potential drinking water supply, and the South Adams County Water and Sanitation District (SACWSD) draws municipal supplies from the area north of the Landfill. There is currently a limited use of ground water for crop irrigation and livestock watering in the area. The SACWSD, irrigation, and livestock watering pathways will be assessed as part of the entire Sand Creek Industrial Superfund Site under OU4.

Exposure pathways that were quantitatively evaluated for local residents under the potential future land-use scenario are: ingestion of groundwater contaminants in drinking water, inhalation of VOCs from ground water while showering, dermal exposure to irrigation water derived from ground water, dermal exposure to surface water for children potentially wading in the spring discharge area, and inhalation of ambient air from vapors emanating from the Landfill. Risks associated with aquatic life coming into direct contact with surface water were also quantitatively assessed for the hypothetical future scenario.

Estimated current and potential future risks were based on an average or most likely exposure concentration (MLE) and a reasonable maximum exposure concentration

Table 1. Chemicals and Media of Concern for the 48th and Holly Landfill (OU3 and OU6), Sand Creek Industrial Superfund Site.

CHEMICALS OF CONCERN	SURFACE WATER	GROUND WATER	AIR
VOLATILE ORGANICS:			
Benzene	X	X	X
Chloroform	X	X	X
1,2-Dichloroethane (1,2-DCA)	X	X	
1,1-Dichloroethene (1,1-DCE)	X	X	X
1,2-Dichloroethene (1,2-DCE)	X	X	
1,2-Dichloropropane	X	X	
Tetrachloroethene (PCE)	X	X	X
1,1,1-Trichloroethane (1,1,1-TCA)	X	X	
Trichloroethene (TCE)	X	X	
1,1,2-Trichloroethane (1,1,2-TCA)	X	X	
Vinyl Chloride	X	X	X
SEMIVOLATILE ORGANICS:			
Naphthalene	X	X	
INORGANICS:			
Antimony	X	X	
Arsenic	X	X	
Barium	X	X	
Cadmium	X	X	
Fluoride	X	X	
Manganese	X	X	
Mercury	X	X	
Nickel	X	X	
Vanadium	X	X	
ADDITIONAL VOLATILE ORGANICS FOR AIR			
Chlorobenzene			X
Toluene			X

(RME) using concentrations of COCs in ground water and surface water. Because of limited numbers of groundwater samples for each well location and the need to compute exposure point concentrations for each individual well, RME concentration values were established as the maximum detection on a per well basis. The MLE concentrations were computed as the arithmetic mean of the data collected for each well. For air, maximum concentrations modeled for the previous RA were used as exposure point concentrations, since the OU3 RA does not consider operation of the OU6 LFGES. The exposure point concentrations for COCs in ground water, surface water, and air are presented in Table 2.

Intakes of COCs for each of the exposure scenarios were calculated separately by exposure route and then summed. The exposure assessment was structured to address potentially sensitive subpopulations, including children. Exposure assumptions used to estimate risk associated with MLE and RME exposure scenarios are presented in Table 3.

C. Risk Characterization

Potential health risks to humans are expressed in two ways: carcinogenic (cancer causing) and non-carcinogenic. For carcinogens, it is assumed that there is no safe dose, but that the risk of cancer lessens as the dose decreases. Cancer potency factors (CPFs) or slope factors are used for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. Excess lifetime cancer risk is determined by multiplying the intake level by the CPF. These risks are probabilities and are generally expressed as excess cancer risks. An excess lifetime cancer risk indicates the chance, over and above the background average risk (approximately one in four), that an individual has of developing cancer as a result of exposure to a carcinogen over a 70-year lifetime under specific exposure conditions. In determining the need for remedial action at Superfund sites, EPA guidance states that the total excess cancer risk for all contaminants must fall below the range of one chance in ten thousand (1.0E-04) to one chance in one million (1.0E-06).

Non-carcinogenic risks are calculated by assuming that there is a dose below which no adverse health effects will occur. This dose is referred to as the reference dose (RfD) and is used to estimate the hazard quotient (HQ) associated with the potential exposure to non-carcinogens. HQs are determined by calculating the ratio of the estimated intake level to the RfD. A hazard index (HI) can be generated by adding the HQs for all chemicals having similar target organs or critical effects within a medium, or by adding HQs across all the media to which a population may reasonably be exposed. The HI provides a useful reference point for evaluating the potential significance of multiple contaminant exposures within a single medium or across media. An HI of 1 is identified in the NCP as a Superfund site remediation goal.

Table 2. Chemicals of Concern and Exposure Point Concentrations

CHEMICALS OF CONCERN	SURFACE WATER (μg/L)		AIR (mg/m^3)				GROUND WATER (μg/L)[c]	
	MLE[a]	RME[b]	@10 feet[c]	@600 feet[c]	@0.75 miles[c]	@1.25 miles[c]	MLE max[c]	RME max[d]
VOLATILE ORGANICS:								
Benzene	0.3	0.5	4.00E-5	6.30E-05	5.60E-05	1.32E-04	303	540
Chloroform	0.8	1.0	2.57E-04	1.61E-04	8.40E-05	5.60E-05	37.0	37.0
1,2 Dichloroethane (1,2-DCA)	0.5	0.5	---	---	---	---	11.5	25.0
1,1-Dichloroethene (1,1-DCE)	13.7	15.0	0.00E-06	0.00E-06	4.10E-05	2.74E-04	1500	1500
1,2 Dichloroethene (1,2-DCE)	46.3	53.0	---	---	---	---	443	920
1,2 Dichloropropane	0.5	0.5	---	---	---	---	10.5	25.0
Tetrachloroethene (PCE)	21.0	23.0	1.23E-04	2.37E-04	1.93E-04	4.02E-04	3700	5500
1,1,1-Trichloroethane (1,1,1-TCA)	13.7	15.0	---	---	---	---	3177	7200
Trichloroethene (TCE)	10.0	11.0	---	---	---	---	1350	2400
1,1,2-Trichloroethane (1,1,2-TCA)	0.5	0.5	---	---	---	---	10.5	25.0
Vinyl Chloride	1.0	1.0	6.00E-06	4.20E-05	2.70E-05	8.00E-06	30.0	50.0
SEMIVOLATILE ORGANICS:								
Naphthalene	5.0	5.0	---	---	---	---	130	140
INORGANICS:								
Antimony	12.0	12.0	---	---	---	---	57.9	87.1
Arsenic	1.5	1.9	---	---	---	---	43.3	81.7
Barium	48.9	48.9	---	---	---	---	1090	1090
Cadmium	1.5	1.5	---	---	---	---	9.1	13.1
Fluoride	1900.0	1900.0	---	---	---	---	14,000	14,000
Manganese	68.4	72.4	---	---	---	---	12,560	24,520

Table 2. Chemicals of Concern and Exposure Point Concentrations (Continued)

Mercury	0.9	1.1	---	---	---	---	0.7	1.7
Nickel	6.0	6.0	---	---	---	---	1918	3830
Vanadium	5.1	5.1	---	---	---	---	28.0	28.0
ADDITIONAL VOLATILE ORGANICS FOR AIR								
Chlorobenzene	---	---	0.00E-06	3.00E-06	5.00E-06	2.70E-05	---	---
Toluene	---	---	1.86E-04	3.48E-04	2.24E-04	1.79E-04	---	---

[a] MLE = Most likely exposure concentration

[b] RME = Reasonable maximum exposure concentration

[c] Ambient air exposure point concentrations were modeled (ES, 1987). Values shown are maximum concentr tions estimated for receptors at the indicated distance from the source. Distance/Receptor: 10 feet = trespassers; 600 feet = local residents or nearby workers; 0.75 mile = nearest developed neighborhood; 1.25 miles = nearest school.

[d] Groundwater concentrations are from 31 wells within, upgradient, and downgradient of the landfill. Wells included may be affected by chemicals from other sources.

[e] MLE concentrations were calculated for individual wells. The value shown is the highest groundwater MLE concentration reported.

[f] RME concentrations were calculated for individual wells. The value shown is the highest groundwater RME concentration reported.

Source: OU3 RA (IHA, 1993)

Table 3. Exposure Assumptions Used to Estimate Risks for MLE and RME Scenarios

PARAMETER	UNITS	MLE	RME
Averaging Time	days	25,550 (carcinogens/adult) 3,285 (noncarcinogens/adult) 3,285 (noncarcinogens/child)	25,550 (carcinogens/adult) 10,950 (noncarcinogens/adult) 3,285 (noncarcinogens/child)
Body Weight	kg	70 (adult) 18 (child)	70 (adult) 18 (child)
Dermal Surface Area (surface water)	cm^2/event	3,000 (adult) 1,500 (child)	3,000 (adult) 1,500 (child)
Exposure Frequency (non-surface water)	days/year	350 (adult) 350 (child)	350 (adult) 350 (child)
Exposure Frequency (surface water)	events/year	7 (adult) 7 (child)	62 (adult) 62 (child)
Exposure Duration	years	9 (adult) 9 (child)	30 (adult) 9 (child)
Exposure Time (surface water)	hours/day	2.0 (adult) 2.0 (child)	2.6 (adult) 2.6 (child)
Ingestion Rate (water)	l/day	1.4 (adult) 0.7 (child)	2.0 (adult) 1.0 (child)
Inhalation Rate (air)	m^3/day	20 (adult) 5 (child)	20 (adult) 5 (child)

Source: OU3 RA (HLA, 1993).

The RME and MLE cancer and non-cancer risk estimates by exposure pathways for current and potential future land-use scenarios at the study area are presented in Table 4.

1. Current Human Health Risks

Under the assumption that the LFGES is no longer functioning and nearby residents are exposed to maximum concentrations of chemicals in air, the inhalation of ambient air is the greatest contributor to carcinogenic risk for the current land-use scenario. Total mean RME and MLE cancer risk estimates for dermal exposure to surface water and inhalation of vapors from ambient air are both approximately 4.0E-05. This total RME and MLE cancer risk for the current scenario does not exceed the highest acceptable risk of 1.0E-04 but exceeds the point of departure for assessing the need for remedial action of 1.0E-06, as defined by the NCP. For the current land-use scenario the total HI is less than 1 and indicates there are no unacceptable potential adverse non-carcinogenic health effects.

Though ground water in the area is classified as a potential drinking water supply by the State of Colorado, there is no unacceptable current health-risk due to ingestion, inhalation, or skin contact with contaminated ground water since water for residential use is provided through treated water from either the Denver Water Department or SACWSD. The operation of the LFGES currently eliminates emissions from the Landfill. However, if the LFGES was not operating, the estimated cancer risk for inhalation of landfill gas vapors would be approximately four people in 100,000.

2. Future Human Health Risks

As part of the human health risk assessment for the potential future land-use scenario, the domestic use of ground water was evaluated. Individual cancer risks and hazard indices were calculated for 31 well locations within the study area for the hypothetical future groundwater-use scenario. Estimated risk levels for this scenario indicate that RME cancer risk exceeds 1.0E-04 near the southeast and northwest portions of the Landfill, and that 1,1-DCE, vinyl chloride, and arsenic are the primary contributors to the total carcinogenic risk in these areas. These values represent risks posed to humans using alluvial ground water for domestic purposes. The total site-wide RME cancer risk of 3.0E-03 for the potential future land-use scenario is greater than the target risk range of 1.0E-06 to 1.0E-04. Similarly, the total MLE cancer risks for the potential future land-use scenario of 4.0E-04 also exceeds the target risk range. The pathway contributing the most to the overall cancer risk for the potential future-use scenario is the domestic use of ground water. Cancer risk associated with inhalation of gas vapors in the future could be as high as 2.0E-06 risk for children and 9.0E-07 risk for adults assuming continuous exposure to maximum chemical concentrations.

Table 4. Total Cancer and Non-Cancer Risk Estimates by Exposure Pathway for Current and Potential Future Scenarios.

EXPOSURE PATHWAY	CANCER RISKS		NON-CANCER RISKS	
	MLE	RME	MLE	RME
<u>Current Use</u>				
• Dermal Exposure to Surface Water (Child)	5.0E-09	6.0E-08	<1	<1
• Inhalation of Ambient Air[*] (Child located at nearest school)	4.0E-05	4.0E-05	<1	<1
TOTALS	4.0E-05	4.0E-05	<1	<1
<u>Potential Future Use</u>				
• Ingestion of Ground Water	2.0E-04	1.0E-03	4 (adult) 7 (child)	7 (adult) 13 (child)
• Inhalation of VOCs from Ground Water	2.0E-04	2.0E-03	<1 (adult) <1 (child)	<1 (adult) <1 (child)
• Dermal Exposure to Ground Water	1.0E-08	7.0E-07	<1 (adult) <1 (child)	<1 (adult) <1 (child)
• Inhalation of Ambient Air[*] (Local residents)	9.0E-07 (adult) 2.0E-06 (child)	9.0E-07 (adult) 2.0E-06 (child)	<1 (adult) <1 (child)	<1 (adult) <1 (child)
TOTALS	4.0E-04	3.0E-03	4 (adult) 7 (child)	7 (adult) 14 (child)

[*] Risk estimates for the inhalation of ambient air pathway represent baseline conditions and assume that the LFGES is not in operation.
Source: OU3 RA (HLA, 1993).

For non-carcinogenic contaminants, the potential future land-use scenario exhibits total HIs in excess of 1 (see Table 4). These elevated HIs are associated with the hypothetical domestic use of ground water and are attributed to the individual exceedances of HQs for PCE (critical effect: liver), antimony (critical effect: blood), manganese (critical effects: the central nervous and respiratory systems), fluoride (critical effect: tooth enamel), and nickel (critical effect: body weight).

In summary, the risk analysis indicates that the greatest contributing pathway to the total cancer risk for a potential residential future land-use scenario would be the domestic use of ground water. Potential cancer risks for this pathway range from one person in one thousand to one person in one hundred at OU3/OU6. The risk (above background) of contracting cancer from ground water in the vicinity of the site is currently estimated to be highest southeast and northwest of the Landfill. The risk calculations also indicate that there is a potential for adverse health effects resulting from exposure to non-carcinogenic contaminants through groundwater ingestion.

3. Risk Associated with Methane Gas

Methane, the component of landfill gas that presents the greatest explosion risk, is combustible when present in air at concentrations between 5 percent and 15 percent. Potential explosive risks were virtually eliminated with the installation of the LFGES during the spring of 1991. However, if the LFGES were to malfunction, fail, or cease operating outside of the normal course of O&M activities, then explosive conditions could occur at the Landfill. It is not possible to quantitatively predict health risks that could be associated with failure of the system.

4. Environmental Risk

The potential hazards to environmental receptors were qualitatively evaluated in the OU3 RA. Terrestrial and aquatic habitats present at the Landfill were described and individual species known to occur in the vicinity were identified. No federally threatened or endangered plant or animal species are known to be present at the Landfill.

Exposure of terrestrial receptors to COCs in ground water is considered remote because ground water is not accessible except at the point of discharge into the marsh. Exposure point concentrations and maximum concentrations of COCs in surface water collected at the marsh were compared to federal ambient water quality criteria (AWQC) and state water quality standards for protection of aquatic life. Maximum surface water concentrations were lower than AWQC and state standards for all COCs having an established standard. Based on the expected chemical fate, incomplete exposure pathways, low chemical concentrations, and comparison of COC concentrations in surface water to aquatic life protection criteria, environmental impacts associated with the Landfill are expected to be minimal.

In conclusion, the OU3 RA indicates that actual or threatened releases of hazardous substances from this Landfill, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

VII. DESCRIPTION OF ALTERNATIVES

A. Remedial Actions Already Implemented

Remedial actions that have already been implemented at the Landfill under the OU6 Removal Action include soil cover improvements, installation and operation of the LFGES, and construction of a perimeter fence and warning signs. In 1992, a soil cover system improvement program was initiated to address erosion, poor drainage, and lack of vegetative cover. Approximately 62,000 cubic yards of fill was placed in designated areas of the Landfill to provide a minimum cover depth of 2 feet. The soil cover was graded to improve runoff characteristics and revegetated to promote evapotranspiration and control erosion.

An active gas extraction system was installed in 1991 to control the accumulation of landfill gas and eliminate odors and toxic gas emissions. The LFGES consists of a series of 75 gas extraction wells interconnected by over 15,700 feet of piping. Two centrifugal blowers alternately operate to induce the flow of gases from the gas extraction wells. The extracted gas is conveyed to a 50-foot high enclosed flare system for treatment before release to the atmosphere. Condensate generated by the gas extraction system is collected in 4 sumps and conveyed to a 10,000 gallon storage tank. The condensate is discharged from the storage tank to a sanitary sewer for treatment in a publicly owned treatment works (POTW) operated by the City and County of Denver. Twenty-two gas monitoring probes (in addition to the 6 previously existing probes) were installed around the perimeter of the Landfill to monitor the performance of the LFGES. These probes are sampled monthly to monitor methane concentrations and gas pressure. The system is operated so that the concentration of methane within the probes does not exceed 5% by volume.

In an effort to limit human access to the Landfill, a 3-strand, smooth wire fence was erected around the perimeter of the Landfill in 1991. Signs are posted on the fence to warn against trespassing and hazardous conditions. In addition, EPA has issued an Access Order to Colorado Paint Company (CPC), which allows EPA, LI, and BNR to control the activities that can be conducted on the Landfill for a period of up to 25 years in order to protect the integrity of the response action. EPA has entered into an access agreement with the Colorado and Eastern Railroad Company (CERC) which allows

EPA and authorized representatives to conduct and maintain response actions on the CERC property. As discussed previously, EPA has also issued a Unilateral Order for OU6 that provides for implementing, operating, and maintaining the LFGES.

B. Alternatives Developed for the Landfill

The detailed analyses of remedial alternatives, presented in the Focused Feasibility Study (FFS) for OU3, resulted in the development of three alternatives for site remediation. These alternatives are summarized below:

1. Alternative 1: No Action

The Superfund program requires that the "No-Action" alternative be considered at every site. Under this alternative, EPA would take no action to control the source of contamination. However, groundwater monitoring and a site review would be conducted at least every five years.

Under this alternative, the operation of the LFGES would be discontinued. The landfill soil cover system and existing institutional controls would not be maintained, and the perimeter fence would not be repaired or maintained. Alternative 1 would therefore not provide for any additional remediation of affected media within OU3/OU6. Ceasing operation of the LFGES would likely result in an accumulation of landfill gas beneath the Landfill. Erosion would degrade the integrity of the landfill soil cover system. Natural fate processes, including degradation and attenuation, would continue to reduce contaminant concentrations in ground water over time. A groundwater monitoring program would be implemented, and periodic site reviews would also be conducted.

2. Alternative 2: No Further Action

The major components of this alternative are: continued operation and maintenance of the LFGES, continued maintenance of the landfill soil cover system, continuation of existing institutional controls, continued maintenance of the perimeter fence and warning signs, implementation of a groundwater and landfill gas monitoring program, and periodic site reviews.

Under this alternative, the LFGES would continue to extract and treat landfill gas and maintenance would be performed as necessary. A landfill gas monitoring program would be used to assess the operational performance of the LFGES.

The landfill soil cover system would be maintained. Revegetation and soil cover maintenance would be performed as necessary to maintain landfill appearance, promote evapotranspiration, control runon and runoff, prevent excessive erosion of soil cover, and provide a barrier to direct contact with landfill contents.

Alternative 2 would include continued maintenance of the OU6 Administrative Order, OU6 Access Order, and the CERC access agreement. The perimeter fence and warning signs would be maintained in order to control access to the Landfill. Repairs would be made as necessary to the fence, and signs would be replaced if damaged or stolen to prevent trespassing.

Natural fate processes, including degradation and attenuation, would continue to reduce contaminant concentrations with time in ground water. A groundwater and landfill gas monitoring program would be implemented and periodic site reviews would also be conducted.

3. <u>Alternative 3: Engineering and Institutional Controls</u>

Under Alternative 3, a combination of institutional and engineering controls would be implemented in the vicinity of the Landfill to limit exposure to affected media. The major components of Alternative 3 are: continued operation and maintenance of the LFGES and continued maintenance of the soil cover system, with improvements to both as required during the normal course of operation and maintenance (O&M) activities; continued maintenance of the perimeter fence and warning signs; continuation of existing institutional controls; implementation of additional institutional controls, as necessary; implementation of a groundwater and landfill gas monitoring program; and periodic site reviews. If warranted, remedial action will be taken at OU3/OU6 if new information obtained from the groundwater monitoring program indicates that the Landfill contributes unacceptable levels of contamination to the ground water.

The Administrative Order for the OU6 LFGES, the Colorado Paint Company (CPC) Access Order, and the CERC access agreement already preclude certain activities at the site that would be inconsistent with or interfere with the response actions for OU6. Current zoning prohibits residential development on most of the Landfill (i.e., the CPC and BNR portions of the site). Additional institutional controls may be utilized as necessary in Alternative 3 to supplement the controls that are already in place to ensure that the response action remains effective. Furthermore, EPA would have continuing oversight authority over response actions at the Landfill. EPA approval may be required for activities at the site beyond continued O&M of the LFGES, the soil cover system, and fencing/warning signs to the extent that such activities would interfere with or be inconsistent with the response action. The primary purposes of the institutional controls would be: (1) to protect the integrity of the soil cover system in order to prevent dermal or direct contact with the landfill contents, (2) to prevent the use of ground water underlying the Landfill as a drinking water source, and (3) to protect the LFGES.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, alternatives developed for OU3/OU6 of the Sand Creek Industrial Superfund Site are evaluated and compared to each other using the nine evaluation criteria required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to identify the alternative that provides the best balance among the criteria. The relative performance of the alternatives is summarized by highlighting the key differences among the alternatives in relation to the following criteria:

1. Overall Protection of Human Health and the Environment
2. Compliance with Applicable, or Relevant and Appropriate Requirements (ARARs)
3. Long-Term Effectiveness and Performance
4. Reduction of Toxicity, Mobility, or Volume Through Treatment
5. Short-Term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance

A. Criterion 1: Overall Protection of Human Health and the Environment

This criterion is categorized as a threshold criterion (i.e., alternatives must pass this criterion to remain in the evaluation). This criterion assesses the protection afforded by each alternative, considering the magnitude of the residual risk remaining at the site after the response objectives have been met. Protectiveness is determined by evaluating how site risks from each exposure route are eliminated, reduced, or controlled by the specific alternative. The evaluation also takes into account short-term or cross-media impacts that result from implementation of the alternative remedial activity.

Overall protection of human health and the environment would be provided by Alternatives 2 and 3. Alternative 1, the No-Action alternative, would not provide adequate protection of human health and the environment, because (1) ceasing operation of the LFGES would increase the likelihood of explosion and increase the potential for inhalation of landfill gas and (2) discontinuing maintenance of the soil cover system and the perimeter fence with warning signs would increase the potential for direct contact with landfill contents. Alternative 3 would provide even greater overall protection of human health and the environment than the current sufficient protection afforded by Alternative 2 because the implementation of additional institutional controls, as necessary, within OU3 would further reduce the risks associated with (1) potential future use of ground water and (2) potential for direct contact with landfill contents. In addition, Alternative 3 includes a provision for making improvements to the LFGES and soil cover system, as required, to ensure adequate protection of human health and the environment.

B. Criterion 2: Compliance with ARARs

This criterion is also a threshold criterion in that all alternatives must attain ARARs to be considered as site remedies or, if ARARs are not attained a justifiable ARARs waiver must be obtained. Section 121(d) of the Superfund Amendments and Reauthorization Act (SARA) mandates that for all remedial actions conducted under CERCLA, cleanup activities must be conducted in a manner that complies with ARARs. The NCP and SARA have defined both applicable requirements and relevant and appropriate requirements as follows:

- Applicable requirements are those federal and state requirements that would be legally applicable, either directly, or as incorporated by a federally authorized state program.

- Relevant and appropriate requirements are those federal and state requirements that, while not legally "applicable," are designed to apply to problems sufficiently similar to *hose encountered at CERCLA sites that their application is appropriate. Requirements may be relevant and appropriate if they would otherwise be "applicable," except for jurisdictional restrictions associated with the requirement.

- Other requirements to be considered are federal and state non-regulatory requirements, such as guidance documents or criteria. Advisories or guidance documents do not have the status of potential ARARs. However, where there are no specific ARARs for a chemical or situation, or where such ARARs are not sufficient to be protective, guidance or advisories should be identified and used to ensure that a remedy is protective.

Federal and state ARARs which must be considered include those that are: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs govern the extent of site cleanup in terms of actual cleanup levels. For example, Colorado Interim Organic Pollutant Standards (CIOPS) for stream segments classified for aquatic life and/or water supply are chemical-specific ARARs for the site. Location-specific ARARs govern natural site features such as wetlands, floodplains, and man-made features such as archeological and historic areas. Action-specific ARARs are technology or activity-based requirements that set restrictions on particular kinds of action at CERCLA sites.

Alternatives 1, 2, and 3 would comply with ARARs. Since no remedial action would be implemented under the No-Action alternative, there are no action-specific

ARARs for Alternative 1. Analyses of samples collected in the spring discharge area during the OU3 RI indicate that the CIOPS are not exceeded. The investigation of OU3 also revealed that there are no listed archeological or historic properties, or endangered or threatened species present at the Landfill. In addition, it is not expected that the remedial activities associated with OU3/OU6 would adversely impact any wetlands at or near the Landfill.

The next five criteria are designated as balancing criteria. These criteria are used to measure the positive and negative aspects of performance, implementability, and cost for each alternative.

C. Criterion 3: Long-Term Effectiveness and Permanence

The focus of this evaluation is to determine the effectiveness of each alternative with respect to the risk posed by treatment of residuals and/or untreated wastes after the cleanup criteria have been achieved. Several components were addressed in making the determinations, including:

- Magnitude of residual risk from the alternative.
- Likelihood that the alternative will meet process efficiencies and performance specifications.
- Adequacy and reliability of long-term management controls providing continued protection from residuals.
- Associated risks in the event the technology or permanent facilities must be replaced.

Comparison of alternatives with respect to long-term effectiveness and permanence indicates that Alternative 3 would provide the most effective and permanent remedial solution for OU3/OU6. Alternative 1 would not reduce the residual risk at the Landfill since it does not include provisions to maintain existing controls that would manage untreated materials at the Landfill. Under Alternative 1, hypothetical risks would likely increase after ceasing operation of the LFGES and discontinuing maintenance of the soil cover system. Alternative 3 is more effective and permanent than Alternative 2. Alternative 3 includes additional institutional controls, as necessary, and provisions for improvements to the LFGES and the soil cover system, as required. Therefore, Alternative 3 provides more reliable controls for future management of untreated materials at the Landfill than Alternative 2.

D. Criterion 4: Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion evaluates the ability of the alternatives to significantly achieve reduction of the toxicity, mobility, or volume of the contaminants or wastes at the site, through treatment. The criterion is a principal statutory requirement of CERCLA. This analysis evaluates the quantity of contaminants treated and destroyed, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction, the degree to which the treatment will be irreversible, the type and quantity of residuals produced, and the manner in which the principal threat will be addressed through treatment. The risk posed by residuals will be considered in determining the adequacy of reduced toxicity and mobility achieved by each alternative.

Alternatives 2 and 3 would reduce the toxicity, mobility, or volume of landfill gas through extraction and treatment while landfill gas COC concentrations, mobility, and volume would likely increase under Alternative 1. Maintenance of the soil cover system would continue to reduce the mobility of landfill contents under Alternatives 2 and 3. The provision in Alternative 3 for modifications of the LFGES and the soil cover system, as required, ensures that reductions in toxicity, mobility and volume of landfill gas and reduction in the mobility of landfill contents would be maintained in the event of changing conditions at the Landfill. However, under present conditions, Alternatives 2 and 3 are essentially equivalent with respect to reducing toxicity, mobility, or volume.

Under Alternatives 2 and 3, the toxicity of landfill gas would be significantly reduced by the flare system, which incinerates the extracted gas. The mobility of landfill gas would be controlled through capture and extraction by the LFGES. Review of 1992 gas monitoring probe data indicates that the mobility of methane has been substantially reduced since operation of the LFGES began. The volume of landfill gas would be reduced through extraction and treatment by the LFGES. Currently, approximately 700,000 cubic feet of landfill gas per day are collected and treated by the LFGES.

The mobility of the landfill contents would be reduced through continued maintenance of the soil cover system and would thereby minimize the potential for direct contact with landfill contents. The soil cover system prevents transport of refuse by animals as well as by wind and erosion. The soil cover system does not contribute to a reduction in the toxicity or volume of the landfill contents. However, the toxicity of the landfill contents may be reduced by natural biodegradation.

Alternatives 2 and 3 would not provide a reduction in the toxicity, mobility, or volume of contaminated ground water beyond those processes occurring naturally. Reductions in toxicity as a result of natural attenuation and biodegradation processes may occur in ground water. Volatilization of organic compounds may result in a minor reduction in volume.

Alternative 1 would not reduce the toxicity, mobility, or volume of landfill gas, ground water, or landfill contents beyond what would occur through natural degradation and attenuation processes.

E. Criterion 5: Short-Term Effectiveness

The short-term effectiveness of each alternative was assessed based on the risk associated with the implementation of the remedial action to the community, workers, and environment and the time required to achieve the response objectives. Measures to mitigate releases and provide protection are central to this determination.

The evaluation of the alternatives indicate that all three are essentially equivalent with respect to short-term adverse environmental impacts and protection of the community and workers. With the exception of the groundwater monitoring program and additional institutional controls, as necessary, all remedial actions associated with Alternatives 2 and 3 have already been implemented. Alternative 3 may involve future improvements to the LFGES and soil cover system, but adverse short-term impacts should be minimized through standard engineering controls and adherence to standard health and safety practices. Because no remedial actions are proposed under Alternative 1, no potential short-term exposure to the community, construction workers, or additional impacts to the environment would occur as a result of implementing a remedial action.

F. Criterion 6: Implementability

This criterion analyzes technical feasibility, administrative feasibility, and the availability of services and materials. Technical feasibility assesses the difficulty of construction or operation of a particular alternative and unknowns associated with process technologies. The reliability of the technologies based on the likelihood of technical problems that would lead to project delays is critical in this determination. The ability to monitor the effectiveness of the alternative is also considered.

Administrative feasibility assesses the ease or difficulty of obtaining permits or rights-of-way for construction. Availability of services and materials evaluates the need for off-site treatment, storage, or disposal services, and the availability of such services. Necessary equipment, specialists, and additional resources are also evaluated in determining the ease by which these needs could fulfilled.

Each of the alternatives evaluated would be technically feasible. No additional construction, maintenance, or operations beyond those already existing would be required under any of the alternatives with the exception of Alternative 3, which may require improvements to existing systems. These improvements are expected to be readily implementable because no implementation difficulties were experienced during the installation of the LFGES and improvement of the soil cover system. The groundwater monitoring program included in Alternatives 1, 2, and 3 is technically implementable because existing groundwater monitoring wells would be utilized to accomplish the proposed monitoring. The off-site monitoring of landfill gas included in Alternatives 2 and 3 is also technically implementable since existing monitoring probes would be used.

It is unlikely that the regulatory agencies or the public would accept shutdown of the LFGES as proposed under Alternative 1. Alternative 2 would be administratively feasible. Institutional controls, as necessary, in Alternative 3 would require additional legal effort to be implemented and would be dependent in certain instances on cooperation of property owners and municipalities or other governmental entities, and satisfaction of legal requirements. Alternative 2 would likely be the easiest to implement with respect to administrative feasibility because no additional actions would be required.

G. Criterion 7: Cost

Alternatives are evaluated for cost in terms of both capital costs and long-term O&M costs necessary to ensure continued effectiveness of the alternatives. Capital costs include the sum of the direct capital costs (materials, equipment, labor, land purchases) and indirect capital costs (engineering, licenses, or permits). Long-term O&M costs include labor, materials, energy, equipment replacement, disposal, and sampling necessary to implement the alternative. The objective of the cost analysis is to eliminate those alternatives that (1) do not provide measurably greater protection of human health and the environment, and (2) include costs that are substantially greater than those of other alternatives.

The present worth analysis is used to evaluate expenditures that would occur during different time periods. By discounting all costs to a common base year (i.e., 1992), the costs could be compared on the basis of a single figure for each alternative. Total present worth costs were calculated by multiplying the capital and O&M cost incurred during each year by the present worth factor. An interest rate of 5 % and a project duration of 30 years was used in accordance with EPA guidance.

The total present worth costs are identical ($7,283,000) for Alternatives 2 and 3 since the additional expenditures required for Alternative 3 (i.e., additional institutional controls and required improvements to the LFGES and soil cover system, as necessary) cannot be estimated. A total present worth cost of $4,316,000 is estimated for Alternative 1. Operation and maintenance costs incurred to date were included for Alternative 1, but future O&M for the LFGES and soil cover system were excluded since this alternative proposed discontinuation of these systems. Total annual O&M costs for Alternative 1 include only the implementation of a groundwater monitoring program and periodic site reviews and are estimated at $47,000. For both Alternatives 2 and 3, total estimated capital costs and annual O&M costs are $3,170,000 and $240,000, respectively. However, capital costs for Alternative 3 are likely to be somewhat higher than indicated due to costs associated with additional institutional controls, if necessary.

H. Criterion 8: State Acceptance

This modifying criterion evaluates technical and administrative issues that may be raised by the State. EPA has involved CDH throughout the RI/FS and remedy selection process. The State of Colorado concurs with EPA's selected alternative, as presented in Section IX.

I. Criterion 9: Community Acceptance

This modifying criterion evaluates questions and comments on the Proposed Plan received from members of the community. It appears that the community supports EPA's selected remedy, as presented in Section IX. No comments on the Proposed Plan were received by EPA during the public comment period. Therefore, preparation of a Responsiveness Summary for this ROD was not necessary.

IX. SELECTED REMEDY

Based on consideration of the requirements of CERCLA and the detailed analysis of alternatives, EPA with the concurrence of the State of Colorado has determined that Alternative 3, Engineering and Institutional Controls, is the most appropriate remedy for OU3/OU6 of the Sand Creek Industrial Superfund Site. This remedy includes extraction and treatment of landfill gas; maintenance of the soil cover system and LFGES with improvements, as required; maintenance of the perimeter fence and warning signs; implementation of additional institutional controls, as necessary; implementation of a monitoring program and site reviews; and additional remedial action, as necessary, if monitoring indicates that the Landfill contributes to unacceptable contamination of ground water. The PRPs will be responsible for maintenance of each component of the remedy.

The detailed analysis of alternatives shows that for overall protection of human health and the environment; effectiveness; and reduction of toxicity, mobility or volume, the selected alternative is superior to Alternatives 1 and 2. The selected remedy and Alternative 2 are essentially equivalent in terms of technical and administrative feasibility, although cooperation of landowners or governmental entities may be necessary for implementation of certain additional institutional controls under the selected alternative. Costs for the selected remedy and Alternative 2 are also similar, however, there may be additional costs for the selected alternative due to costs associated with additional institutional control implementation, if necessary, and any improvements required to the LFGES and soil cover system during the normal course of O&M activities.

The selected remedy incorporates removal, treatment, and containment technologies. The principal components of the selected alternative are described below in greater detail. Capital and annual O&M costs for these components are presented in Table 5.

Landfill Gas-Extraction System: The LFGES was installed within the boundaries of the Landfill during the spring of 1991 as part of the OU6 landfill gas Removal Action. The LFGES has the following primary components: seventy-five landfill gas-extraction wells; gas collection piping, consisting of a main header and 13 subheaders; four condensate sumps, piping, and a knockout pot; a 10,000-gallon condensate storage tank; two gas-extraction blowers and ancillary equipment; an enclosed gas flare system and a blower building; and 22 gas monitoring probes. Condensate collected in the storage tank is discharged via a sanitary sewer to the Denver Metro Central Treatment Plant. The LFGES is designed to capture as much of the landfill gas within the Landfill as possible and minimize its vertical and lateral migration via the extraction wells and gas collection piping. The enclosed flare system destroys odors and toxic components of the landfill gas. The gas monitoring probe network monitors the LFGES performance. Based on results from the gas monitoring probes and extraction wells sampled weekly and evaluated quarterly, the LFGES is adequately capturing methane and mitigating off-site gas migration. The preferred alternative provides for improvements or upgrades to the LFGES, as required.

Soil Cover System: Site improvements were undertaken at the Landfill during the spring of 1992 to enhance the integrity of the soil cover system and improve general erosion control and site appearance. The site improvements were also expected to improve O&M of the LFGES by reducing infiltration of ambient air into the Landfill. The site improvements consisted of: (1) the placement, grading, and compaction of approximately 62,000 cubic yards of fill material; (2) the placement of fill in low/eroded areas and the construction of terraces and straw bale dikes to control surface-water runoff; and (3) the revegetation of approximately 30 acres and interseeding of 8 acres of the Landfill. Under the preferred alternative, the soil cover system will be maintained (i.e., mowing the grass and spot reseeding as necessary) and improved as conditions at the Landfill warrant. The need for additional improvements to the soil cover system will be based on visual indications, such as surface erosion or a lack of vegetation.

Fencing: The Landfill is currently fenced with a 3-strand smooth wire fence that was installed in August 1991. Warning signs are posted around the entire perimeter of the fence. Maintaining the wooden fence posts, repairing broken strands of wire, and replacing warning signs as required will ensure that the fence will continue to be an effective deterrent to public access to the Landfill.

Table 5. Cost Summary for the Selected Remedy[a]

Capital Costs:	
• Landfill Gas Extraction System	- $2,470,000
• Landfill Soil Cover System	- $ 673,000
• Perimeter Fence	- $ 16,000
• Groundwater Monitoring Program Design	- $ 11,000
TOTAL CAPITAL COSTS	- $3,170,000
Estimated Annual O&M Costs:	
• Landfill Gas Extraction System	- $ 152,000
• Landfill Soil Cover System	- $ 40,000
• Groundwater Monitoring Program	- $ 36,000
• Periodic Site Assessment	- $ 11,400
TOTAL ANNUAL O&M COSTS	- $ 240,000 (rounded)
TOTAL PRESENT WORTH (1992 $)[b]	- $7,283,000 (rounded)

[a] The capital costs of the selected remedy are likely to be higher than indicated due to costs associated with implementation of additional institutional controls, as necessary. However, these costs were not included because of uncertainties in estimating costs associated with negotiating and implementing the additional institutional controls.

[b] Total present worth costs assume an annual discount rate of 5% and a project duration of 30 years.

Source: OU3 FFS (HLA, 1993).

Institutional Controls: The purposes of the institutional controls component of the selected alternative are (1) to protect the integrity of the soil cover system to prevent dermal or direct contact with the landfill contents, (2) to prevent the use of ground water underlying the Landfill as a drinking water source, and (3) to protect the LFGES operating at the Landfill. These objectives are already achieved in part through EPA oversight of the response action; state restrictions on permitting and constructing water wells in areas of known contamination; and maintenance of the existing controls under the OU6 Order, the CPC Access Order, and the Consent for Access on CERC property. Additional institutional controls that may be implemented as necessary include further EPA Orders issued pursuant to CERCLA § 106, judicial Consent Decrees under CERCLA § 122, zoning and subdivision regulations, building permits, recording requirements, state statutes, and local ordinances. Institutional controls currently in place at OU3/OU6 as well as available and potential supplemental institutional controls are summarized in Appendix A.

OU3 Monitoring Program: The OU3 monitoring program consists of groundwater and landfill gas monitoring components. Under the preferred alternative, both components will be implemented or continued. The duration of the OU3 monitoring program will be established in a Unilateral Order. The groundwater monitoring component is designed to assess changing conditions in Aquifers 0 and 2, and to continue evaluation of the Landfill's impact on groundwater quality. Key elements of the monitoring program include: annual sampling of 3 existing upgradient wells, annual sampling of 6 existing downgradient wells, annual sampling of one location at the spring discharge area, and proposed target analytes based on the results of the OU3 RI.

The landfill gas monitoring component was implemented with the startup of the LFGES in the spring of 1991. The perimeter network of 22 gas monitoring probes will continue to be monitored to evaluate the performance of the LFGES. In addition, six gas monitoring probes existing on the northwest perimeter of the Landfill prior to the OU6 Removal Action will also continue to be monitored to provide additional information regarding system performance and the migration of landfill gas. The LFGES is operated so that the concentration of methane within the monitoring probes does not exceed 5% by volume.

Data from both components of the OU3 monitoring program will support assessment of landfill conditions and LFGES performance as well as the need for improvements as provided for under the selected remedy. In addition, the data will be used to assess the site and ongoing activities during the periodic site review. In the future, if it is determined that the Landfill is responsible for unacceptable groundwater contamination, the remediation of ground water at the Landfill will be addressed under OU3.

X. STATUTORY DETERMINATIONS

EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for a site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is justified. The selected remedy must also be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatments that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following discussion addresses how the selected remedy meets these statutory requirements.

A. Protection of Human Health and the Environment

EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (1988) indicates that protectiveness may be achieved by reducing exposure through actions such as containment, limiting access, or providing an alternate water supply. The remedial actions described for the selected remedy will permanently address the principal threats to human health and the environment for OU3/OU6 through treatment to reduce the toxicity, mobility, and volume of landfill gas and containment of landfill contents. Concentrations of contaminants of concern in the spring discharge area do not exceed preliminary remediation goals, so remedial action objectives for aquatic life have been achieved. The risks associated with potential future activities at the Landfill will be addressed by the implementation of additional institutional controls, if necessary.

Though CERCLA favors active remediation, institutional controls may be implemented under CERCLA in appropriate circumstances. As provided by the Preamble to the NCP (55 Federal Register 8666, 8706 [March 8, 1990]):

> Examples of institutional controls, which generally limit human activities at or near facilities where hazardous substances, pollutants, or contaminants exist or will remain onsite, include land and resource use and deed restrictions, well drilling prohibitions, building permits, and well use advisories and deed notices. EPA believes ...that institutional controls have a valid role in remediation and are allowed under CERCLA (e.g., Section 121(d)(2)(B)(ii) appears to contemplate such controls). Institutional controls are a necessary supplement when some waste is left in place, as it is in most response actions. Also, in some instances where the balancing of tradeoffs among alternatives during selection of remedy process indicates no practicable way to actively remediate a site, institutional controls such as deed restrictions or well-drilling prohibitions are the only means available to provide protection of human health.

Institutional controls are particularly suited for application at municipal landfills. For example, as provided in EPA's *Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites* (1991):

> For municipal landfill sites, the major purpose of deed restrictions is to protect the integrity of the cap. The restrictive covenant should limit subsurface development (excavation), excessive vehicular traffic (including off-road vehicles), and groundwater use. Additional deed restrictions may be required for effective implementation of other technologies. The permissible uses/limitations for the specific landfill property should be identified based on the risk the site poses and the remedial actions likely to be implemented.

B. <u>Compliance with ARARs</u>

All federal and state ARARs will be met by the selected remedy. Federal and state ARARs which must be considered include those that are: chemical-specific, location-specific, and action-specific. Potential ARARs identified for OU3/OU6 are provided below.

Chemical-Specific ARARs:

- Colorado Interim Organic Pollutant Standards (CIOPS) for Stream Segments Classified for Aquatic Life.

Sampling data from OU3 indicates that none of these standards are exceeded. Therefore, the selected alternative complies with this potential ARAR.

Location-Specific ARARs:

- Archeological and Historic Preservation Act, 16 USC § 469;40 CFR § 6.301(c).

The investigations of OU3 have not revealed any data that would trigger the effect of the Act or its regulations. The selected remedy will comply with this potential ARAR.

- National Historic Preservation Act (NHPA), 16 USC § 470; 40 CFR § 6.301(b); 36 CFR Part 800.

Studies of OU3 have not revealed any historic properties that would trigger the effect of this Act or its regulations. The selected alternative will comply with this potential ARAR.

- Colorado Register of Historic Places, Colo. Rev. Stat. § 24-80.1.101, et seq., 8 CCR 1504-5.

Studies of OU3 have not revealed any historic properties that would trigger the effect of this Act or its regulations. The selected alternative will comply with this potential ARAR.

- Endangered Species Act, 16 USC § 1531, et seq.; 50 CFR Part 17; 40 CFR § 6.302(h).

Studies of OU3 have not indicated the presence of any listed species that would trigger the effect of this Act or its regulations. The selected alternative will comply with this potential ARAR.

- Non-Game Endangered or Threatened Species Conservation Act, Colo. Rev. Stat. § 32.101, et seq.; 2 CCR 406-8.

Studies of OU3 have not indicated the presence of any listed species that would trigger the effect of this Act or its regulations. The selected alternative will comply with this potential ARAR.

- Executive Order on Protection of Wetlands, Executive Order No. 11990; 40 CFR § 6.302(a).

The U.S. Fish and Wildlife Service does not believe that the remedial activities associated with OU3 will adversely impact any wetland that may be present at or near the Landfill (letter dated June 6, 1991 from the U.S. Department of the Interior). Therefore, the Executive Order and its regulations are not ARARs for OU3. In the event that the OU3 remedial activities adversely impact any wetlands at OU3, the Executive Order and regulations may be ARARs.

Action-Specific ARARs and Guidance To Be Considered (TBC):

- Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites (EPA, 1991).

EPA has provided guidance specifically intended to address the remediation of municipal landfills. In particular, the guidance addresses the type of cover suggested for municipal landfills and recognizes a soil cover as sufficient to prevent dermal contact with landfill contents. It is apparent that EPA's municipal landfill guidance is not an ARAR (see NCP, 40 CFR § 300.400(g)(3)). However, as an Agency guidance, it may be a TBC for OU3.

- Potential Action-Specific ARARs Pertinent to Operation of the Gas Collection System at OU6, as set forth in the Sand Creek Industrial Superfund Site OU6 EE/CA (HLA, 1990).

  Gas Collection System:

  - Clean Air Act, 42 USC §§ 7401 et seq., National Ambient Air Quality Standards (NAAQS).

  NAAQS are ARARs for the Landfill. The landfill area is an attainment area for sulfur dioxide, nitrogen dioxide, and lead, and a non-attainment area for particulates, carbon monoxide, and ozone. However, since the gas collection system is not expected to exceed NAAQS levels during the remedial action, this requirement is relevant and appropriate.

  - Colorado Air Pollution Control Regulations, 5 CCR 1001-1 et seq.

  Based on experience with other similar gas removal systems and the performance of the OU6 LFGES to date, it is not expected that the LFGES will qualify as a major stationary source. However, if the gas collection system should ever qualify as a major stationary source, the pertinent substantive requirements applicable to major stationary sources in the Colorado Air Pollution Control Regulations would be potential ARARs.

  - Colorado Solid Waste Disposal Sites and Facilities Regulations, 6 CCR 1007-2, Section 2.

  These regulations include requirements concerning explosive gas concentrations at solid waste disposal facilities. Section 2.2.5 requires that explosive gas concentrations be monitored regularly. Section 2.2.6 limits explosive gas concentrations for solid waste facilities and requires that the concentration of explosive gases must not exceed 1% by volume of air within facility structures or 5% by volume of air at the site boundary. Section 2.4.4 provides that concentrations of explosive gases generated by the facility for solid waste disposal shall not exceed 5% in the air at the site boundary after closure. These requirements are potential ARARs for the gas collection system.

Condensate Management:

- RCRA Subtitle C Requirements, 6 CCR 1007-3.

The condensate generated from operation of the LFGES should not be a hazardous waste because it is not a listed waste and it is not derived from a listed hazardous waste. Based on sampling of condensate from the LFGES and past experience with landfill condensate, it is not expected that concentration limits set forth in the TCLP rule will be exceeded or that the condensate will otherwise exhibit a characteristic of hazardous waste. Therefore, RCRA Subtitle C requirements should not be ARARs for the management of condensate. In the unlikely event that (1) the condensate exhibits a characteristic of a hazardous waste, and (2) the condensate is not managed in a manner excluded from RCRA Subtitle C regulation, requirements pertinent to the management of the condensate would be potential ARARs.

- Compliance with Colorado Discharge Permit System Regulations, 5 CCR 1002-2.

Substantive provisions of these regulations would be potential ARARs in the event that management of the condensate involved a point source discharge to Sand Creek. However, condensate will be stored in a 10,000-gallon storage tank and discharged to a POTW.

- Federal Pretreatment Regulations

Colorado has adopted the federal General Pretreatment Regulations for Existing and New Sources of Pollution, 40 CFR Part 403, as amended 55 Fed. Reg. 30082 (July 24, 1990). Therefore, Colorado regulations will not be more stringent than federal regulations, which are potential ARARs since the condensate will be discharged to a POTW.

- Local Pretreatment Rules

Section 121(d) of CERCLA does not require CERCLA response actions to comply with local laws (i.e., local laws by themselves are not

ARARs). While local pretreatment requirements technically are not considered to be ARARs, the LFGES is expected to comply with applicable provisions of these requirements.

C. Cost Effectiveness

The selected alternative is cost-effective in its approach to remediating landfill gas, containment of landfill contents, and restricting access to the site. The OU3 monitoring program will allow assessment of the conditions at the Landfill relative to (1) groundwater contamination attributable to the site and (2) accumulation and migration of landfill gas. The analysis of sampling data collected will allow for cost-effective decisions regarding any future improvements that may be required for the remedial systems. Total capital, annual O&M, and present worth costs for the selected remedy are $3,170,000; $240,000; and $7,283,000; respectively. However, if implementation of additional institutional controls are necessary, capital costs for the selected remedy are likely to be higher than indicated.

D. Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable for the 48th and Holly Landfill. Specifically, the use of the LFGES to extract and treat landfill gas results in a permanent reduction in methane and concentrations of COCs in landfill gas through thermal destruction. Condensate generated by the operation of the LFGES will be treated by a POTW. Because no hot spots were located within the Landfill, it was considered impractical and unnecessary to remediate landfill contents. Direct contact with landfill contents will be eliminated by containing the refuse beneath the landfill cap.

Of the alternatives that are protective of human health and the environment and comply with ARARs, EPA believes that the selected remedy provides the best balance in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; short-term effectiveness; implementability; cost; and the statutory preference for treatment as a principal element. Overall protection of human health and the environment, and long-term effectiveness and permanence were the most decisive criteria in selecting Alternative 3 as the preferred remedy.

The selected remedy offers greater overall protection of human health and the environment than afforded by Alternatives 1 or 2 because future potential exposure pathways for ground water are addressed through additional institutional controls, as necessary. Alternative 1 would not be protective of human health or the environment. The preferred alternative provides the greatest long-term effectiveness by including provisions for future modifications and improvements to the LFGES and soil cover system as required during the normal course of O&M activities. The selected remedy and Alternative 2 are essentially equivalent with respect to the evaluation of compliance with ARARs; reduction of toxicity, mobility, or volume; short-term effectiveness; and implementability. Alternative 1 would not reduce residual risk associated with landfill gas, landfill contents, or groundwater exposure pathways; nor would it employ any treatment options that would reduce the toxicity, mobility, or volume of contaminants in the media of concern. Alternative 1 is also not likely to be administratively feasible. The additional capital expenditure for the selected alternative associated with implementation of additional institutional controls, as necessary, is not expected to be significant in comparison to Alternative 2.

E. Preference for Treatment as a Principal Element

The selected remedy satisfies the statutory preference for treatment as a principal element and is fully consistent with the NCP. Operation of the LFGES to extract and treat landfill gas addresses the principal threat posed by landfill gas. The LFGES will reduce the potential for explosion and inhalation hazards by mitigating the migration and accumulation of landfill gases. Combustible and toxic components of the landfill gas will be permanently destroyed through thermal destruction by the flare system. Condensate generated from the extraction of landfill gas will be treated by the Denver Metro POTW.

The size of the Landfill and the fact that there are no on-site hot spots that represent the major sources of contamination preclude a remedy in which contaminants could be excavated and treated effectively. However, hazards associated with exposure to landfill contents will be minimized through containment by maintaining the soil cover system. Groundwater contamination attributable to the Landfill is not considered to be a principal threat, and potential exposure pathways for ground water have been addressed to the extent practicable.

Because this remedy will result in hazardous substances remaining on-site, a review will be conducted every five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

APPENDIX A

SUMMARY OF INSTITUTIONAL CONTROLS FOR OU3/OU6

Table A.1. Institutional Controls Currently in Place at OU3/OU6.

Institutional Control	Purposes of Institutional Control
OU6 Order	Requires implementation of methane gas recovery system; restricts activities to the extent that such activities conflict with response actions at OU6, and requires continued maintenance of response action.
Access Order	Allows access to CPC property by BN, LI and EPA in order to allow such parties to conduct OU6 removal action on CPC property; restricts present and future activities on CPC property which would interfere with removal action.
Consent for Access	Provides access for Response Actions to be conducted by EPA and its authorized representatives on CERC property.
EPA Oversight Activity	Precludes activities at site that would interfere with response actions, unless approved by EPA.
State of Colorado's Office of State Engineers, State Board of Examiners of Water Well Construction and Pump Installation Contractors (revised effective July 30, 1988), Rule 10.2.2	Precludes permitting and construction of wells in areas of known contamination.

Table A.2. Available Supplemental Institutional Controls.

Institutional Control	Purposes of Institutional Control
Commerce City Zoning "AG"	*Limits the types of development allowed in the CERC property.*
Commerce City Zoning "I-3"	Prohibits residential development on CPC property, and consequently prohibits water wells serving the residential development.
Denver Zoning "I-2"	Prohibits residential development on Burlington Northern property, and consequently prohibits water wells serving the residential development.
Denver and Commerce City Subdivision Regulations	Requires title check and review of proposed subdivision by various government agencies which should disclose any recorded information relating to the prior use of the Site as a landfill or any methane hazards disclosed therein.
Commerce City Subdivision Regulations	Requires water sampling in order to prevent use of unpotable water, if any, under the Site.
Denver and Commerce City Building Departments/Uniform Building Code	Requires soil borings and/or excavations to determine content of soils under proposed development site; prohibits issuance of building permits where dangerous conditions exist.
Denver and Commerce City Subdivision Regulations/Recording of other Documents in Appropriate Real Property Records	Requires recording in the appropriate county records of any existing or future Unilateral Order or Consent Decree affecting the Site. Such recording be disclosed by any title search required by the Subdivision Regulations and inform reviewing agencies of the prior use of the Site as landfill and/or any existing methane hazards.

Table A.3. Potential Additional Supplemental Institutional Controls

Institutional Control	Purposes of Institutional Control
Further EPA Orders issued pursuant to CERCLA § 106	May serve itself as institutional control and provide further use restrictions against property owners as necessary for response actions.
Judicial Consent Decree under CERCLA's § 122	May serve itself as institutional control and provide further use restrictions against property owners as necessary for response actions.
Correspondence to Colorado Land Use Commission and local governments requesting designation of Site as "Area of Interest" under the Land Use Act	To obtain a designation of the Site as a "Area of Interest" under the Colorado Land Use Act, requiring all potential developers to obtain a permit prior to development of any portion of the Site.
Ordinances adopted by Commerce City and/or Denver under their police powers.	To adopt well bans.
Easement in Gross	Voluntary landowner control granted to restrict development of property.
Colorado Excavation Statute/filing of appropriate notices with Denver and Adams County Clerk and Recorder	To require any potential developer on the property to provide notification of any proposed excavation on the Site.